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CZECHOSLOVAK SMALL AND MEDIUM TRACTORS

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[Comment: This report gives the specifications and operational data on two Czechoslovak-made tractors as reported in the Russian-language periodical Avtomobil'naya i Traktornaya Promishlennost'. The operational data of the two diesel tractors, the Zetor-15 and Zetor-25, was based on tests conducted by the Soviet NATI (State Union Scientific Research Tractor Institute). Many of these tractors are being made for export.]

In connection with the conversion of the Soviet tractor park to diesel engines, the Czechoslovak Zetor-15 and Zetor-25 diesel tractors made by Zbrojovka (Armaments Factory) in Brno are of great interest to the Soviet tractor industry.

The Zetor-15 and Zetor-25 are general purpose tractors. They can operate effectively in agricultural work with conventional tractor-drawn implements, and also with mechanical implements driven from a power take-off shaft, in stationary pulley-operated work, and in transportation as tractor trucks.

Although the Zetor-15 and Zetor-25 tractors are produced in plants of the same machine-building combine, their design shows only external similarity. The basic technical specifications of the tractors are:

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## SPECIFICATIONS OF ZETOR-15 AND ZETOR-25 TRACTORS

<u>Tractors</u>	<u>Zetor 15</u>	<u>Zetor 25</u>
Type of tractor	General purpose wheel type	General purpose wheel type
Weight (kg)	1,480	1,880
Over-all dimensions (mm)		
Length	2,700	3,200
Width	1,550	1,320
Height	1,515	1,715
Road clearance (mm)	320	280
Wheel base (mm)	1,560	1,900
Speed (km/hr)		
First gear	4.0	3.2
Second gear	5.7	5.3
Third gear	8.5	8.0
Fourth gear	13.5	13.4
Fifth gear	23.0	20.0
	--	31.2
	3.0	2.7 and 11.7
Engine		
Type of engine	Four-cycle compressor-less diesel	Four-cycle compressor-less diesel
Number of cylinders	1	2
Cylinder bore (mm)	120	105
Piston stroke (mm)	140	120
Rpm	1,500	1,800
Total piston displacement (liters)	1.58	2.21
Compression ratio	14.7	20.0
Capacity of engine (hp)	15.0	25.0
Fuel consumption (kg/hr)	3.4	5.8
Specific fuel consumption (gr/brake hp-hr)	228 - 235	225 - 230

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<u>Tractors</u>	<u>Zetor 15</u>	<u>Zetor 25</u>
Fuel (basic.)	Diesel oil	Diesel oil
Number of main bearings on crankshaft	2	3
Fuel pump	Bosch-type	Bosch-type
Injectors	Bosch-type	Bosch-type
Injection pressure (kg/sq cm)	85	150
Type of governor	All-speed	Two-speed
Type of oil pump	Plunger	Gear
Oil filter	Sectional	Screen type
Air cleaner	Screen type	With oil bath
Starting mechanism	Crank handle and glow plugs	Electric starter, crank handle, and glow plugs
<u>Transmission</u>		
Type of clutch	Constant-mesh, single-plate	Constant-mesh, single-plate
Type of transmission	Mechanical 5 forward speeds, one reverse speed	Mechanical, 6 forward speeds, two reverse speeds
Brakes	Foot brakes; shoe brakes on driving wheels; hand brake; band brake on differential	
Main transmission	Bevel gears	Bevel gears
Final drive	Spur gears	Spur gears
Pulley for stationary work	Attached to rear wall of transmission housing, pulley axis perpendicular to tractor axis	
<u>Undercarriage</u>		
Driving wheels:	Low-pressure balloon tires	Low-pressure balloon tires
Type Size (inches)	9 x 24	11.25 x 24
Pressure in tires (kg/sq cm)	1.0	1.0
Guiding wheels:		
Type	High-pressure balloon tires	High-pressure balloon tires

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<u>Tractors</u>	<u>Zetor 15</u>	<u>Zetor 25</u>
Size (inches)	5.5 x 16	5.5 x 16
Pressure in tires (kg/sq cm)	2.0	2.0
Tread of driving wheels (mm)	1,270 - 1,450	1,200 - 1,560
Tread of guiding wheels (mm)	1,270 - 1,450	1,200 - 1,560

Zetor-15 Tractor

The arrangement of the components in the Zetor-15 tractor corresponds to the generally accepted design of wheel tractors of the frameless type. The frame of the tractor consists of the engine and clutch housings and rear end assemblies bolted together.

The engine, which is located in the front part of the tractor, transmits the torque via the clutch and connecting drive to the transmission, then through the bevel gear pair and the main spur gear to the axle shafts.

The engine is of monobloc design, with a turnover combustion chamber, which does not provide fully satisfactory operational economy. The cylinder is equipped with a "wet" sleeve made of hardened cast iron. The main bearings of the engine are cylindrical roller bearings, and the connecting rod bearings are fitted with replaceable bushings lined with loaded bronze.

The valves are of the overhead type. The cast aluminum-alloy piston has five piston rings, of which three are compression rings and two are oil control rings.

The crankshaft journals are of ample diameter to permit the required number of grindings.

The fuel is fed by gravity from the tank located in the rear of the engine, through a sedimentation tank to an auxiliary pump, and then through a filter (felt element) to the plunger of the fuel pump. The pump forces the fuel to the enclosed-type injectors.

The pump is equipped with an all-speed centrifugal governor with fuel-feed control.

Diesel-engine lubricating oil is filtered by a sectional screen filter. The oil is changed after every 120-140 hours of engine operation. The oil is circulated by a plunger pump.

The engine is water-cooled, with forced circulation.

The starting equipment consists of a crank handle and glow plugs which are fed by a 6-volt storage battery.

In starting, the engine is cranked with the decompressor connected. Then the decompressor is disconnected and fuel is fed into the engine at the same time.

The clutch housing is bolted to the rear surface of the engine block. The constant-mesh type clutch sleeve is controlled by a foot pedal located at the left side of the tractor.

The clutch sleeve transmits power to the transmission through a shaft without a connecting coupling (universal joint).

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The transmission is an aggregate mounted in one casting with the rear-end housing which is bolted to the clutch housing. The transmission has five forward speeds and one reverse speed. The tractor uses direct transmission and a longitudinal location of the shafts. This layout is advantageous in the general grouping of the design components of the tractor, and, in this particular case, provides for a common oil bath for the transmission and the rear-end housing.

To prevent the possibility of damage to the gear teeth by premature or spontaneous gear disengagement, the forks of the shifter shafts are interlocked with the clutch engagement mechanism.

The rear-end housing contains the bevel-gear drive and the final spur-gear drive with a two-spider pinion simple bevel-gear differential; and power is transmitted to the driving axle shafts of the tractor through the axle shaft gears.

The drive wheel disks are fastened to cast-iron drums fixed on the axles. The double-shoe brakes, placed in the drums, are controlled by the right foot of the operator with the aid of two pedals located to the right of the transmission, one pedal for each wheel. The pedals are interlocked by a cross shaft, as a result of which the braking action is transmitted simultaneously to both wheels, which is necessary when traveling on paved highways at considerable speeds.

Braking is effected by a hand-lever-operated band brake. The hand lever is located to the left of the transmission, and the brake acts upon the two rear driving wheels.

Changes in the tread of the rear and front wheels are made by turning the wheel disks.

The tractor is equipped with a dynamo, two front headlights, and a rear stop light. To increase the coupling weight of the tractor, two additional loads, 80 kilograms each, are mounted on the disks of the driving wheels [ballast?]. The tractor is equipped with a radiator hood and fenders. On the instrument panel there is a gauge indicating the pressure in the main oil line; as well as a remote-control thermometer, indicating the temperature of the water in the cooling system.

#### Zetor-25 Tractor

The general grouping and disposition of the mechanisms in the Zetor-25 tractor are the same as in the Zetor-15 tractor. Therefore, only mechanisms which are substantially different from the above will be discussed.

The engine is of monobloc design, located in the front part of the tractor, and has the same head for both cylinders, with precombustion chambers, which are not very satisfactory from the standpoint of economy.

The main bearings and the connecting rod bearings, unlike those of the Zetor-15 tractor, have replaceable steel inserts lined with leaded bronze. The journals of the crankshaft are of a diameter of 70 (crankpin) and 80 millimeters (main), as a result of which the shaft can permit a considerable number of grindings.

Starting is effected by a starting mechanism, consisting of crank handle, electric starter, and glow plugs which are fed by a 6-volt battery. The procedure for starting the engine is the same as for the Zetor-15.

The coupling of the engine with the transmission is similar to that of the Zetor-15.

The transmission has six forward speeds and two reverse speeds.

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The transmission embodies an original design, which is not widely used in tractor building. This design (with additional carriage) provides for a considerable number of speeds without complicating the general grouping of the tractor transmission, and also (as is the case in the Zetor-15) permits use of a joint oil bath for the transmission and the rear-end housing.

The rear-end housing contains the reduction shaft with coupled bevel drive pinions, four spider pinions, and a final drive with reduction spur pinions of conventional design, by means of which power is transmitted to the driving axle shafts of the tractor.

The driving disks in the rear wheels are attached to cast-iron hubs, which in turn are attached to the axle shafts. Band brakes around the differential shaft are controlled by two foot pedals located to the right of the transmission, one pedal for each rear wheel. The pedals may be interlocked as in the Zetor-15. Braking is effected by a hand lever located to the left of the transmission. This brake affects both wheels. Changes in the tread of the rear wheels are obtained by shifting the hubs along the axle shafts, to which they are affixed by four bolts. Changes in the tread of the front wheels are obtained by shifting the extensible part of the front axle a required number of holes and bolting it in position.

To increase the coupling weight of the tractor, four additional weights totaling 350 kilograms are mounted on the driving wheels.

For working in excessively damp soil, the tractor is equipped with metal wheels with wedge-like soil-gripping lugs, 120 millimeters high.

The Zetor-15 and the Zetor-25 tractors were subjected to laboratory, field, and operational tests in the vicinity of Moscow in heavy clay.

The efficiency in field tests of the Zetor-25 tractor was somewhat low because of unfavorable soil conditions (excessive dampness), and also because of unsatisfactory traction of the 11.25 x 24-inch balloon tires, a size not commensurate with the engine power. To obtain better traction, larger balloon tires must be used.

The basic operational tests were made in fall plowing. The capacity of the Zetor-15 tractor, at a plowing depth of 20-21 centimeters, was 0.15-0.18 hectare per hour; and of the Zetor-25, 0.26-0.30 hectare per hour. The fuel consumption was 16-18 kilograms per hectare.

Particular attention during field tests was paid to starting at various outdoor temperatures and to performance of the starting equipment.

Starting the Zetor-15 tractor with the engine cold was difficult even during the summer. It took from 2 to 6 minutes and considerable physical effort to turn the engine over. A warm engine, during both the summer and autumn periods (at temperatures as low as minus 2 degrees centigrade) would start without trouble.

Starting of a chilled engine during the autumn tests (at temperature of minus 2 degrees centigrade) was very difficult and took from 5 to 10 minutes. Starting was somewhat facilitated by pouring hot water into the radiator, but a considerable physical effort was still required, although the starting time was lowered to from 3 to 5 minutes. A warmed-up Zetor-25 engine could be started easily with the aid of the crank handle in the same amount of time as the Zetor-15. Starting a cold engine with the aid of the crank handle only, even in summer, turned out to be practically impossible.

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An attempt to determine starting characteristics by using the self-starter failed on account of damage to the starter caused by a defect in the relay regulator.

Owing to the inconvenient location of the starting mechanism, it took two men to start the engines in both the Zetor-15 and the Zetor-25 tractors.

These tractors have satisfactory transportation speeds, and can be used effectively for hauling.

[See table on following page.]



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## Dynamic Characteristics of Zetor-15 and Zetor-25 Tractors

<u>Tractors</u>	<u>Maximum Engine Horsepower</u>	<u>Gear</u>	<u>Traction Power (kg)</u>	<u>Speed (km/hr)</u>	<u>At Maximum Tractive Capacity</u>		
					<u>Tractive Horsepower</u>	<u>Percent</u>	<u>Efficiency</u>
Zetor 15	14.7	First	737	3.67	10.0	17	68
		Second	470	5.52	9.6	9	65
		Third	300	7.65	8.5	5	58
Zetor 25	24.6	First	925	3.07	10.5	14	43
		Second	815	4.57	13.8	11	56
		Third	540	6.90	13.8	6	56

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